MAIN CURRENTS

IN MODERN THOUGHT

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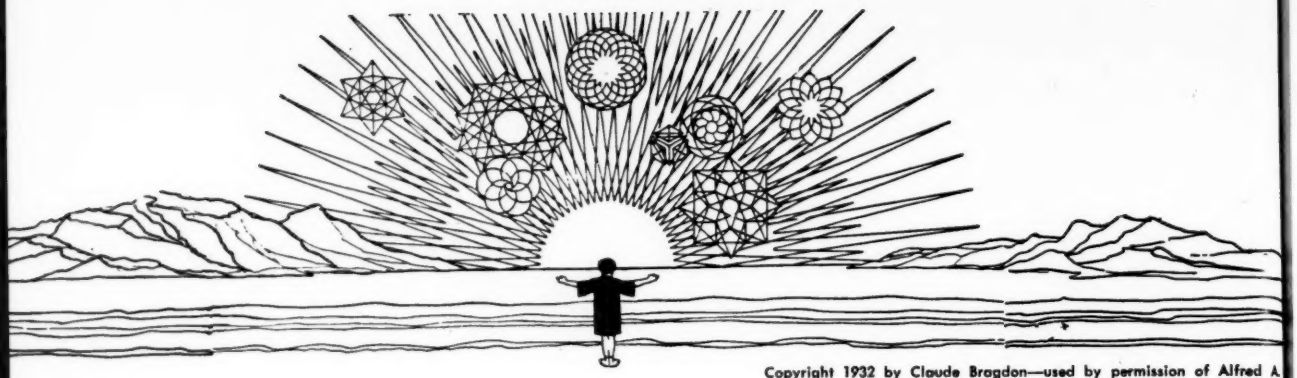

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MAIN CURRENTS

IN MODERN THOUGHT

A cooperative journal to promote the free association of those working toward the integration of all knowledge through the study of the whole of things, Nature, Man, and Society, assuming the universe to be one, dependable, intelligible, harmonious.

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MAIN CURRENTS IN MODERN THOUGHT is published to call attention to significant contributions to learning currently being made in the multiple fields, relating these advances to each other and to classical and contemporary views of Eastern, European and American thinkers. It is designed to save time for the reader by providing a vantage-ground from which the whole world of knowledge may be surveyed and kept in proportion as it moves toward integration. Its editors assume that the principles of art, the universals of philosophy, the laws of Nature and Man as formulated by science, and the truths of comparative religion, can be orchestrated into a harmonic, meaningful, ethical body of teachings which can and should be made the central core of curricula study in the educative process at all levels. Contributors to MAIN CURRENTS enjoy full liberty of opinion and expression in these pages.

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THE MEANING AND THE FAITH OF SCIENCE*

Henry Margenau

Yale University

The Development of Order and Structure Within the Amorphous Matrix of Experience

IN trying to convey something of what science is, I shall discuss primarily two topics, the meaning of science and the faith of science, hoping thereby to give some reasonable dimensions to a term which often escapes us because it is so abstract, so ubiquitous, and so vague. It is always easy to define things in terms of subject matter, of material content. You may recall the student's definition: If it pops, it's Physics; if it smells, it's Chemistry; and if it's incomprehensible, it's Philosophy! Needless to say, that is *not* the kind of definition we are after, when we seek the meaning of science. Our inquiry is not concerned with the subject matter of various sciences, but rather with the peculiar method by which valid knowledge in the sciences—and presumably the non-sciences as well—is achieved.

As a point of attack on the meaning of science, I shall offer three propositions, each one taken from a different field of human concerns. After presenting these three statements I shall argue that the first is non-scientific (please remember that no value-judgment is implied by that phrase); that the second is mildly scientific; and that the third is entirely scientific. The propositions are as follows:

First; if we can imagine that there is a picture before us, we make the statement: "This picture is blue."

For the second we need a little background. About two hundred years ago a scientist called Linnaeus developed an important and useful system of classifying plants and animals. He compared flowers with respect to the number of their stamens, and classified them accordingly: those with one stamen, with two, with three etc.—triandae, quandrandrae, hexandrae, and so forth. Let us select two kinds of plants which ordinarily seem quite different to us, the lily and the bamboo. Our statement is: "These two plants, the lily and the bamboo, belong to the class hexandrae." By this means we have made a judgment respecting certain properties of certain compound individuals called plants.

Our third statement is taken directly from Newton, who helped to establish one of the most exact branches of physical science. It is this: "All bodies attract one another in accordance with an Inverse Square Law of force." This needs a word of explanation. Let us suppose we have here a little body which we call a mass point (small massive object), and another mass over there. If the distance between them is one hundred feet, then the force between these two squared =10,000. If the distance between them increases to one thousand feet, then force is equal to the same constant divided by one-thousand squared = 1,000,000, and so forth. This principle is known in science as the Inverse Square Law of Gravitation.

Let us now consider these three statements more carefully. The first: "The picture is blue," states a fact which is obvious, which is based on immediate visual experience, and which is, in one sense of the word at least, subjective.

The second statement introduces into a consideration of two apparently different plants the idea of congenital similarity (here based on the number of stamens), which induced the botanist of that era to place them into the same category. Such a statement is quite different from that of the first class, for it alludes to certain carefully perceived regularities which the two kinds of individuals named have in common. Statements of this kind—what I have called second-class statements—make up the body of descriptive, classificatory, or correlational science.

Statements of the last, or the third kind, come under the heading of exact, or deductive-exact science. The meaning of this term becomes clear upon closer inspection of the proposition above quoted: "All bodies attract in accordance with the inverse-square law." It should be noted that the sentence abounds with matters which are not immediately perceptible.

In the first statement, everything is clear and simple; everything lies within the plane of immediate perception.

In the second statement things are still on the factual level, and nothing is involved which cannot be seen. Yet such a statement cannot be made without hard work and careful examination of data, that is, of the things being classified.

*A lecture given at the New School for Social Research, Oct. 16, 1956, edited with the author's permission.

The third statement is quite different. First of all, what are these bodies which are spoken of? Newton did not have in mind big bodies, like stars, or even bodies of ordinary size, like stones. In exact interpretation the rule refers only to infinitesimally small bodies, which may be said to have no actual existence, since they are idealizations. The facts stated in the law, if they may be called facts, are not open to immediate inspection. The whole purpose of the third proposition, which is made without the presence, at first, of any evidence of its truth, is that it may be used in certain further calculations. What *follows* from it can be observed as a deduced consequence; it can finally be tested against immediate experience—the kind of experience which is exemplified in statement number one.

Let us make a little scheme which may explain the meaning of the third kind of statement which, as I have said, is characteristic of the exact sciences.

We may begin with statement number three, "all bodies attract, etc., etc.," fully realizing that this could never be justified at the familiar level of immediate experience because it is remote from the plane of direct inspection. However, we can make calculations based on it. For instance we may say that we will suppose the earth *is* made up of bodies all of which attract in accordance with this law, and we will furthermore suppose that the sun is also made up of bodies all of which act in accordance with this law. Upon this supposition, we can then calculate how the sun will act upon the earth, and such an application of the statement is open to examination. We can test the consequence of this law, and in such a way convince ourselves that it is true.

IT should be noted, however, that we have not tested the proposition itself, but only a specific instance or application of it. The proposition says a great deal more than that a particular body, as the sun, attracts another particular body, as the earth; it is a statement of a universal principle, that *all* bodies attract according to this law. But who can test the truth of a universal?

I should like to speak of this again later, in considering the problem of the faith of science. The point I wish to make at the present time is merely this: That as we proceed from the first statement to the second and then to the third we become increasingly abstract. Statements of the first type are immediately apprehensible, testable. Statements of the second type are also, but they need greater care in their apprehension. Statements of the third type require that deductive consequences be inferred from them before any truly empirical test can be made.

As I have said, statements of the first kind are non-scientific, by which we do not mean that they are *unscientific,* but rather that they have very little relevance to science. The second and third statements are generally of a character known as scientific, but they are essentially very different.

The second belongs to primitive or descriptive science, a field including such subjects as zoology, botany, geography, large parts of psychology, large parts of economics, and other social sciences. The third type of statement, however, is scientific in a narrower sense, and because it relies so heavily on abstract ideas, or concepts, implying facts by deduction, it is part of deductive or exact science. It is this kind of statement which expresses the modern mood of science.

SO far we have merely surveyed the scene, without saying anything about *relations* between the three types of statement. I am now going to affirm that there seems to be a tendency in the history of learning to convert statements of type one into statements of type two; and statements of type two into statements of type three.

At the present time the descriptive parts of biology are certainly endeavoring strongly to convert themselves into a science *like* physics, or applied mathematics. The Communists, moreover, would like more than anything in the world to be able to convert economics into a deductive science.

There seems to be a drive in most fields of learning to attain the ideal implicit in the understanding conveyed and the predictions made possible by the abstract routines of physics and mathematics. Whether this tendency is right or wrong, its presence is clearly indicated by a study of the history of human thought.

Transmutations from one type of statement to another are easily cited. Let me give you an instance in which the picturesque one, the non-scientific type-one sort of statement, saying this this picture is blue, converted itself into scientific description. The illustration is also perhaps significant because it suggests that the alleged contrast between the "arts" and the "sciences" may be illusory.

About twenty or thirty years ago, the artist thought of color as a wholly subjective phenomenon. It was something to be seen, to be apprehended, to be appreciated; but it was incapable of scientific treatment. And he was right. Physicists tried again and again to describe colors in terms of their qualities, such as hue or wavelength, and intensity, since it is obvious that one color may show differences of brightness, and that different colors vary in hue. But the fact remained that the painter was capable of producing two canvasses of blue which were identical with respect to hue, and with respect to intensity, and yet produced subjective differences in the beholder. This "scientific" description of color allowed something very important to slip through the net of scientific formulation. It did not catch the whole. The artist was perfectly correct when he insisted that science was too crude to render, to reproduce, and to appreciate the subjective qualities of color.

About twenty years ago, however, some scientists had an idea that there may be other properties in color which can be measured quantitatively besides hue and intensity. And they added to this list a third, a quality called *saturation,* or degree-of-admixture of various colors. With the introduction of the third

variable, it has become possible for the scientist to capture, to reproduce, and to appreciate in a technical way the colors of the artist. Color has thus ceased to be a wholly subjective phenomenon. It has become tractable by scientific means. Thus far we do not have perhaps a wholly "deductive-exact" theory of color, as we have of mechanics. But certainly everything that pertains to it belongs in the class of statement number two; to descriptive science, or colorimetry.

I should like to couple with this simple recital of an historical incident the remark that the art of painting has not suffered at all from the circumstance that the scientist has been able to render, to describe, and to reproduce colors. In fact there is ample evidence that the development has returned great advantage both for the artist and for the appreciating public. For example, it has now become possible to reproduce beautiful works of art more accurately and far more cheaply than was possible before, and we have the means for allowing an increasing number of people to enjoy beauty in purer form. Indeed we have opened new creative possibilities for the artist himself by a scientific treatment of his medium.

Let us now see how a descriptive kind of science can become exact. In ancient Egypt, people had to resurvey their land every spring, when it emerged after the Nile had inundated its banks. For this purpose they used the "three, four, five rule." They divided a rope into twelve equal segments by spacing eleven knots equi-distantly from each other. They put an angle into the rope after the third knot, then after the following fourth, and then they closed the triangle. By so doing, they knew that they had a right angle.

In other words, the Egyptians had all the knowledge that goes into the Pythagorean Theorem, which, you may recall, is that the square of the hypotenuse of a right-angled triangle is equal to the sum of the squares of the other two sides.

This working knowledge of the right triangle which the Egyptians had, was descriptive, observational science. They used it with practical success. But Pythagorus took this factual knowledge and constructed a proof of it, thereby transferring it into a deductive-exact science. This did not make the scientific data any more useful, or necessarily any more extensive. Yet something very important was achieved.

There was instilled in the science of geometry a measure of organization, of logical neatness, of entailment, of coherence, which somehow does not reside within the classificatory procedures of the descriptive sciences. It is not true that the exact sciences allow us to predict where these others do not. I can predict on the basis of this second type of statement that every flower which comes up, and promises to be a lily, is going to have six stamens. The ability to make predictions is not solely characteristic of the exact sciences.

We may say, however, that they are characterized by their ability to find prior reasons for an observed phenomenon; they can infer from concepts where descriptive science can only draw inductive conclusions from the events.

This possibility of "prior explanation," (to use a phrase which at this point is still bound to be vague) resides within the quality which I have just called the internal organization, the logical cohesion, the neatness which inhere within the structure of a deductive-exact discipline.

Let me try briefly to dispel another common misconception. People often believe that when a science becomes deductive and exact it takes on a mathematical structure, and becomes extremely difficult to understand. This is not at all true. The most difficult kind of mathematics is now concerned with statements of the second kind. Statistics, with all its terrifying complications, enters the scene in class two. The mathematics one uses in class three is on the whole much simpler in logical structure than the analytical schemes that are being used in connection with descriptive science.

THROUGHOUT this discourse our concern has been with statements and propositions, both non-scientific and scientific. Yet I should like to emphasize that this has been done principally in order to make the discussion simpler. There is a very prevalent, powerful and respectable school of positivistic thought which believes that all that matters in science and in philosophy is statements, propositions: symbolically expressed judgments. It seems to me that this view excludes from consideration the very heart of science and philosophy, for I believe that each one of the sentences or statements cited above refers to an *experience* which is prior to the statement itself. I believe that there are experiences which occur before they are formalized in language. Hence I am convinced that an analysis of science and of philosophy cannot afford to start with a survey of propositions without missing its aim; it must address itself directly to experiences. For this reason it seems useful to try to classify experiences.

There are certain experiences which are simple, direct, immediate, unformalized, and (in the same sense in which I employed the word previously) subjective. Others involve relations, comparisons between or abstractions from the items of this first kind of experience. Finally, there are experiences which begin with an abstract idea or a theoretical construct and pass on to more concrete experiences. It is plain that these three types correspond to the three statements originally considered; let us therefore shift our discourse from statements to experiences.

It is possible to attack the problem of the meaning of science in another way. It has been claimed that science is a catalogue of certified or certifiable facts, which in their entirety constitute the body of science. Those who accept this view often use the picture-puzzle as the analog of the scientfic task. In solving a picture-puzzle, each piece is selected and

placed next to another. In science the pieces are facts, and they are fitted together so that they somehow match. Thus an initially heterogeneous collection of facts sooner or later results in a certain pattern, and then the scientific problem is solved.

I should like to suggest that there are two flagrant faults with this analogy. The first is that the simile, while true perhaps with regard to factual knowledge, does not refer to basic scientific understanding, and science must encompass both. The very word "understanding" suggests a third dimension which underlies the plane of facts, and therefore it is impossible to comprehend science completely so long as the focus of inquiry remains upon the surface of what is empirically given. The scientist must be fully aware of that nexus of relations, of constructs, of ideas, of principles, which underlies the facts and allows them to be united in logical fashion. In this fertile soil of unifying theory, this texture of ideas, there is rooted the living essence of science.

I might say here that the ideas which underlie the visible data of science are in a certain sense facts themselves. But most people do not think of them in that way, rather considering facts to be the things which are plainly in evidence. Therefore they tend to shun the basic ideas, the concepts and the mathematics which underlie science, as though they were epiphenomena which are not really necessary or important, and which should be disregarded when the facts themselves become thoroughly established.

Another simile often used in this connection is that of the encyclopaedia or the catalogue, as mentioned before. Some philosophers believe that a unity of science will have been achieved when an encyclopaedia is developed in which all the facts of science have been listed. Such a view also ignores the basic structure of concepts which inspire the facts with meaning and significance.

Perhaps this matter can be exemplified by the use of another analog, a growing crystal. So long as the crystallizing substance is liquid, small particles within it behave in random fashion, their motion unpredictable and chaotic.

But as soon as the material begins to crystallize, a little solid nucleus will form somewhere within the molten mass, and from it grows a pattern, which is symmetric, regular, and full of geometric beauty.

It should be noted that the growth of the crystal does not change the chemical properties of the substance; the mass remains essentially the same. Nevertheless the molecules somehow fall into their proper places, and one can even predict where the next one will go. A certain self-propagating order has been produced within this previously-amorphous matrix of substance, but the domain covered by this order has not been degraded, or even altered in any essential characteristic.

Figuratively speaking, this sort of thing takes place when science takes hold of our lives. We all have, to begin with, an unlimited matrix of experiences of type number one. This prescientific knowledge, from which all science starts, is sufficient for our purposes in many important pursuits of our daily lives. It has been estimated that only two percent of the decisions we make within one working day are based on science, all the rest being based upon elements of this amorphous matrix of consciousness which contains common-sense knowledge together with those beliefs, attitudes and desires which motivate our social, ethical and religious behavior. This kind of loosely-coherent, direct experience has, perhaps, instilled within it a drive for becoming ordered, but is *not* ordered, at its birth. As I have said before, this matrix of immediate experience is unlimited. From the inexhaustible ground of being new and ineffable experiences continually arise, and it is impossible to predict what they may be. We can only accept them as they come.

In the growth of science, however, we witness the emergence, within this amorphous matrix, of something that is ordered and structured, and therefore allows understanding and prediction. This occurrence has other things in common with the growing crystal. The crystal does not stop growing unless artificial boundaries are set it, and the same thing is true of science. The crystal heals its flaws as it proceeds; so also, as science grows its contents continue to be modified and improved.

If this anology is accepted, one may draw from it two important conclusions. The first is that, as there is nothing ultimate about the growth of the crystal, there is nothing ultimate about science. Anyone who seeks final answers should not look to science for them. Science is a dynamic process, and therefore has no static, ultimate, or, as James used to say, "stagnant truths." If correctly interpreted, science does permit eternal *questions*. The questions which were raised by the scientists and philosophers of ancient Greece still require an answer. While tolerating eternal questions, however, science provides no eternally valid answers. The scientist is characterized by an eternal search for truth.

The second conclusion is this: like the growing crystal, science is equipped with facilities for self-correction. Therefore, as it progresses we may have confidence that the faults it leaves in its wake are likely to be repaired.

I come now to the faith of science. On the face of it, this subject seems to mix two disparate fields. We dislike talking about faith in science, for in science we know, we understand. Yet it seems to me inevitable to conclude that even so sure a field as science has "Articles of Faith." As I see it there are essentially two of these, the first of which is a little difficult to exhibit. To do so, let me go back to the example of universal gravitation.

We may start with a statement of class one: "I see a stone fall to the ground." This is a fact of observation which can be made more precise by saying that the stone falls to the ground with a certain acceleration. Some might speak of this event as a law of nature, but it is not, since it represents a single occur-

rence. To get a law of nature we must give our statement universality, as: "*All* stones fall to the ground at a certain acceleration, namely, 32.2 feet-per-second-per-second." Note that in such a statement there appears the phrase "All stones," although no one can know this by test or direct experience. However, even this is not a very satisfying proposition, for we want a law that will hold for all bodies, not only for stones. So we generalize: "All *bodies* fall . . ."

But why this strange, particular acceleration of 32.2 ft/sec/sec? In order to make the law still more generally applicable, as we would like it to be, we invoke Newton's law of universal gravitation. But for some purposes even this law is not general enough, and many would like to see it derived from an even more powerful and encompassing proposition, so they turn to Einstein's theory of general relativity, and ascribe the behavior of falling bodies to the metric of space. Thus from Einstein's very abstract law, at least an approximation of the law of Newton can be derived, and from the law of Newton we can in turn derive the simple law that all bodies fall with the acceleration of 32.2 ft/sec/sec., and having stated that law, we can test it by immediate experience.

The point should be made that this does not end the deductive chain. Even now, men are working on theories still more comprehensive than that of Einstein. If they succeed, another link in the chain will have been added at its starting point. Yet there will always be some first link from which we start and from which everything else is deduced, and this first link takes its validity wholly from the success of the ultimate testable conclusions.

This first link is called a *postulate*, and the truth of postulates is a rather interesting thing to consider. There was a time when scientists believed that postulates, which were then called axioms, were obviously true, that they carried within them the affidavit of their validity. The laws of geometry and of logic were considered to be intuitively true. But that era has passed. We now know we cannot be absolutely sure of any postulate. For example, the laws of Euclidean geometry can be replaced by those of several non-Euclidean geometries without inconsistency or detriment to the results that follow. The scientist indeed must make a choice of his postulates. But because we seldom think about this, we tend to forget that certain basic tenets in science are not provable. This involves a gross misrepresentation of the structure of science.

The first elements in the scientific chain of explanation, therefore, the postulates, are matters of belief or, if I may use the phrase, articles of faith. They are accepted, and from them are deduced the consequences, which are then tested against ordinary, simple, immediate experience. If these postulates are then seen to lead, predictively, to all the experiences we are capable of having, we say that they are true. When, however, new experiences violate the postulates, the entire chain must be reforged, including the postulates themselves.

This raises the question: Are all basic postulates in this insecure position? For example, can we not say that mathematics is absolutely certain? Is it not true that two and two is always four? The answer is no. The laws of arithmetic are no more certain than anything else in science. We believe in them because their consequences have been tested in ordinary experience. The truth that two and two is four may be evident in connection with many things to which we have successfully applied the proposition. Certainly it is true for material things, like apples and pears, or fingers and toes. But it is not true for many others. For instance, the laws of arithmetic are not valid when applied to ideas: one idea plus another is *not* always two ideas. They may add up to no ideas at all, for they may be contradictory. The largest and most interesting fields of human interest are those to which the laws of arithmetic do not apply.

ALL the basic principles of science are thus held tentatively, on probation, on faith. Strictly speaking, there is no logical difference between the postulates of science on the one hand, and dedication to norms in ethics, or faith in religion on the other. This is the first kind of faith one finds in science.

There is another kind, sometimes called faith in the uniformity of nature. We all share the conviction that nature will continue to behave in accordance with the same laws as in the past. Bodies do not fall with an acceleraiton of 32.2 ft/sec/sec today, and with 60 ft/sec/sec tomorrow. This is a truly remarkable extrapolation upon the past even if somehow, in our civilized and technological world, our capacity for astonishment at the fact that nature proves so reliable has been dulled. This was not always so. The ancient Hebrews, for example, were very much aware of the miraculous quality of this uniformity, and believed that science needed a charter from heaven. Indeed, if I understand it correctly, that is what the story of Noah's Ark intended to convey.

The Bible statement is that in the beginning there was chaos, terminated by the divine act of creation. Then followed a period of lawlessness and confusion that ended in the Great Flood. One interpretation of the turbulence of this period, elaborated in the Jewish *Talmud*, emphasizes that nature and nature's God did not then act in accordance with consistent principles. There were no natural laws, and hence no possibility for natural science. Lawfulness, behavior in conformity with reasonable principles, was God's gift to Noah, conferred in the beautiful Covenant of the Rainbow.

If I understand this correctly, it means that the order of the universe is a divine gift. It is the gift to believe that we may bank on the stability of occurrences in the world. For there is no formalism of any sort by means of which the universality of law in nature can be predicted or can be proved. Yet without it there could be no science. Thus the universality of natural law is science's second Article of Faith, an article which must be embraced by everyone who hopes to advance the cause of science.

SYNTHESIS IN A DIVIDED WORLD*

Rafael Rodriguez Delgado

Yale University (Research)

An Analysis of Some of the Historical Trends Towards Integration in Our Times

THE Atomic Age has rendered Marxism and many other theories inadequate. The main assumptions of historical determinism and dialectical materialism have been broken down by ideas and events which Marx did not foresee and which, some years later, Lenin could not suspect. The critical period we witness today is only the first chapter of a series of deep theoretical and practical changes that the Soviet system must undergo to adapt itself to a world undreamed of by its predecessors, to coexist peacefully with other countries, and to correlate the different social strata of its own population. In the long run the emerging system, transformed with more or less violence, could not have many things in common with its present condition in this transitional period.

The failure of Marx-Leninism to cope with the events that followed the end of the Second World War was more profound than the bloody errors of Stalin. It was present before the death of Stalin in the Titoist movement and the growing independence of Red China. It is present now in the struggles for independence of Poland and Hungary. Kremlin heads were accustomed to deal in abstract terms with concrete problems. Ideological formulas were to them a good instrument to judge facts and to manage them. Having a socialist blueprint, they were able to evolve a State which fitted more or less the original plans, and having clear aims of struggle and revolution they were capable of finding means to provoke them. Notwithstanding, the results of some of their latest plans have backfired, taking the communist leaders repeatedly by surprise. Faced with a complex network of nations of different technological levels, with diverse class structures and divergent historical traditions, they were unable to fabricate a theoretical tool with which to solve the inner contradictions of their system. On the other hand, faced with destruction in the case of an atomic war, they do not know how to deal with external contradictions. The result has been struggle and revolution in the heart of the Soviet world and a continuous threat of more devastating conflicts over the whole surface of the earth. But the Western world is scarcely better off and dangerous contradictions have arisen everywhere.

However, concrete events in the last few weeks have permitted the first public glimpse of a new ideological force. From the beginning of our century, promising intellectual constructions have been in the making in Europe and America, but they developed silently among groups of scientists. Suddenly the first dramatic appearance of these ideas illuminated the horizon of the Polish revolution and even the blast of the struggle in Hungary and Egypt cannot dim their meaning.

A recent article in *Pravda,* part of which was translated in *The New York Times* of October 21st, stated that the Polish press was spreading "imported poison of an ideology alien to the workers." The Russian newspaper attacked especially an article published in the journal of the Polish Writers Union under the title "Talk with the West," in which its author, Florack, said that the "universal proletarian" is an obsolete concept and that we now have to think of the "universal human being." The bitter attack of *Pravda* was not supported by subsequent official action and Kruschev apologized for it to Gomulka, the new Polish premier. The authority cited by Florack, "more weighty in his eyes than Marx" according to the comment of *Pravda,* is a Belgian journalist, Maurice Lambilliotte, editor of *Synthèses,* a review published in Brussels for the past eleven years, which presents the scientific trend of the movement of synthesis within the framework of the ancient philosophical doctrine of humanism. The main lines of its program, which appears regularly as unsigned editorial statement, is concerned with the need for a new culture capable of deep understanding of the meaning of equilibrium and the interplay of forces in our actual world, based on the thesis that no country or civilization has the monopoly of truth, and that the unity of human beings must be constructed from very diverse sources

*Originally a report to the "Junta Directiva de la Sociedad Venezolana de Sintesis," Caracas, 1955, specially revised and translated by the author.

through the joint effort of many cultures and peoples. Respect for human dignity and recognition of personal values are considered axioms, and imply not only freedom but also justice for the individual. The basic task would be the elaboration of a more universal human type who some day could become a citizen of the political union embracing the world.

Actually, this ideological trend is not yet a completed system. It is a scattering of brilliant ideas and the emerging consequence of a wider theoretical situation whose main features will be described. But the inroads that these concepts have apparently made in Polish communism show the potential force that a reformulation of humanistic and democratic goals could have if made in terms of the twentieth century.

THE theory of synthesis was originated in the historical sciences. We can even trace its inauguration to the year 1900, when the historian Henri Berr founded in Paris the *Revue de Synthèse Historique,* whose main objective was the unified understanding of all particular "histories" of peoples and countries, in order to construct an integral and true history of man. The attempt was not an absolute novelty, but the method was really new. Berr called for the collaboration of scientists of diverse disciplines, stating that it was not possible to have a consistent knowledge of man without the intimate fusion of history, geography, anthropology, sociology and philosophy. At the same time, Hegel's interpretation of history as pure realization of the idea of State, and Marx's conception of history as basically a class struggle, were submitted to scientific and constructive criticism.

Some years later Henri Berr headed a group of French university and political personalities of first rank—among them Paul Doumer and Edouard Herriot—and in 1924 founded the "Centre International de Synthèse." The institution aimed at convergence in the sciences, especially in the historical ones, but its work was somewhat limited to an abstract scientific sphere and its political impact was slight. The ideological declaration of principles issued as the program of the "Centre" stressed the need for a synthesized knowledge that "could reveal his destiny to man." The hope that science could so function was, therefore, clearly expressed, but the means to pursue such a destiny were not so clear. However, the French movement spread quickly through Belgium and Switzerland and in a short time reached American shores. There began to grow on both continents a new kind of criticism of the philosophies of Hegel and Marx, and an original system of interpretation of facts. The unity of man, as a species, was now the principle that emerged slowly in opposition to the supremacy of the concepts of state, race or class. It was, really, an old wine put into a new bottle. This wider conception of human history can be traced as the background of such works as *The Outline of History* of H. G. Wells, which appeared in 1920, and of *"Wege de Kulturgeschichte* published in 1930 by J. Huizinga, in which the Dutch scientist saw synthesis not only as a completion of analysis, but also as its directive force.

I met Henri Berr in Paris in the summer of 1954, in my capacity as General Secretary of the Venezuelan Society of Synthesis, founded in Caracas that same year. When I was received in his small library-study I faced, through a mountain of books and papers, a very tall, emaciated man with fierce and sparkling eyes. We talked about the complementarity of science and philosophy, and on the need for translation of the general results of the knowledge of our age into operative terms to orient human actions toward intelligent and organized ends, avoiding unnecessary frictions. Some months later Henri Berr died, but his work will last. He was one of the pioneers of the idea of giving a general and unified sense to the history of man, based on scientific teamwork.

THE movement of synthesis was growing also in other parts of the world, principally among restricted groups of physicists, mathematicians and natural scientists. In Italy was founded in 1907 *Scientia,* an international review of scientific synthesis. In 1917 there appeared the *Nuova Rivista Storica,* edited by Corrado Barbagallo, which concerned itself primarily with the limitation of the power of the State and the criticism of historical materialism. The events that culminated in Mussolini's march on Rome in 1922, and Italy's situation today, show the apt timing of both theoretical inquiries. After the bitter experiences of the Second World War the "Centro Internationale di Comparazione e Sintesi" was founded in Rome in 1940, and issued in 1947 its first review, *Responsabilitá del Sapere.* The "Centro," headed by Maurizio Raffa and Francesco Severi, aims at cooperation among basic sciences to offer a unitary vision of reality. The review works for a new sense of responsibility in our culture, showing synthesis as "essential supposition of human progress and authentic civilization." Reestablishing human dignity and the values of truth, brotherhood, justice and peace are considered as supreme aspirations.

The democratic Republic of Weimar, established in Germany in 1920, was also aware of the importance of a trend that could integrate ideas. A minister of that Republic, C.-H. Becker, said that synthesis was "a question of to be or not to be" to German science. He could have said, furthermore, that the ideas of synthesis were relevant not only to science, but even to survival, for many human beings were sacrificed later to the antithetic Nazi conception of history. A victorious philosophy of historical synthesis in Europe could have avoided Hitlerism and the Second World War.

The Spanish philosopher José Ortega y Gasset, who died in 1955, was equally aware of the need of building a new frame of reference to understand present problems. "From 1900," he said in 1922, "in strange coincidence with the beginning of our century,

thoughts of a new trend appear on the intellectual horizon." He saw a profound disagreement between them and the scientific ideas of the previous epoch, and at the same time "a rare and suggestive unity of style" in the new form of thinking that was producing "an organism of peculiar ideas of this twentieth century."

In the 1940's appeared in the Netherlands the review *Synthèse,* presented as an international journal for the study of the foundations of science, and in Belgium in 1945 *Synthèses, Revue Europèene,* the cited journal of Maurice Lambilliotte, was established. Two years later a remarkable group met in Brussels, the Institut International des Sciences Theoriques, gathering outstanding scholars from European universities and an American representative, H. Weyl, of the Institute for Advanced Study. It was conceived as a group of scientists of different backgrounds, working for the unity of modern thinking and for the construction of a doctrinal synthesis. They assumed that human minds could cooperate in the search for truth. In this same year of 1947 the first number of *Dialectica,* organ of the movement of Scientific Dialectics was published in Switzerland. Founded by the mathematician Ferdinand Gonseth, its general aim was the construction of a system of thought that could surpass idealistic and materialistic dialectics—Hegel and Marx—from a scientific point of view. That year also the first number of *Studium Generale* was published in Heidelberg, a review tending toward the integration of scientific systems and of their methods of research.

The short-lived review *Theoria* was founded in Madrid in 1953; it voiced its faith in the "impersonal value of truth" and its "respect for the opinion of others." It proclaimed the need for converse and criticism and for "the continual intervention of freedom." Furthermore, it assumed "the primacy of dialectics—which is life—over the blind cult of efficiency and arbitrary voluntarism—which is death."

One of the most recent efforts in this general trend of dialogue and integration of knowledge has been the foundation of the Sociedad Venezolana de Síntesis and its review in Caracas in 1954. Its program states: "The dangerous polarization of our intellectual universe demands a serious attempt to overcome the actual antinomies of human thinking—and consequently in their derived actions—establishing an ideological world that may be shared by the greatest possible number of human beings."

IN the United States the idea of a new philosophy of history was very active and attained its most articulate expression, as acknowledged in the Encyclopedia of the Social Sciences. James Harvey Robinson was one of the pioneers of the historical synthesis with his book *The New History,* published as early as 1912. With wider and more practical scope the Institute of Human Relations at Yale University was founded in 1929, the inspired work of James Rowland Angell, whose central purpose was to evolve a science of social behavior applicable to the practical problems of human welfare.

The trend is still alive, in different form, in the hands of K. F. Mather, Henry Margenau and F. L. Kunz, through the Foundation for Integrated Education, composed of some of the clearest intellects in America. The Foundation seeks "an integrated education for our own country" and at the same time "one that should have world-wide validity." "If we want world peace," says its program, "we must be intellectually equal to the materials of the times. Mankind must speak a universal language of ideas. To do this, we need a human conceptual knowledge through which all may share in cultural advances of the West and cultural heritage of the East and of antiquity. When men understand in common the order and meanings of the planet and universe which are their home, they can start to achieve a common peace; for peace rests on understanding and conflict rests on ignorance."

Many other efforts, such as the *International Encyclopedia of Unified Science,* edited by a group of scientists in Chicago, and the review *Diogenes,* published with the support of UNESCO from 1952, point to the fact that the man of the twentieth century usually has a culture based on the assumptions of the nineteenth century, with which he cannot understand and solve his present problems.

IN the most diverse fields, in the remotest countries, slowly but without halt, is emerging a new effort to elaborate a theory capable of yielding a scientific background of interpretation and discussion to man as a whole. The fragmentary and wrecked systems of the past must be superseded if existence is to continue. If science can be unified to reflect universal truths, it may also develop convergent systems of ideas on whose general lines all human beings can agree. The clues are yet scattered and unconnected, lights that gleam here and there, that are extinguished in one place to be lighted in another. Notwithstanding, the basis for a wider understanding among different political and cultural groups is now here.

In a world ravaged by fierce revolutions, by bloody struggles, by the deadly threat of atomic wars, by ceaseless conflicts of wealth, of boundaries and of ideas, the necessity for an intellectual integration as basis for intelligent coordinate action is no longer avoidable. The power of mind that constructed fearful weapons can also be exercised in the construction of a peaceful world. We must formulate without delay a common philosophy for the human species that can appeal to reason, to intelligence and to sentiment without propagandistic aims. We can destroy our foe, as a great American thinker said, if we change him into a friend. This is possible, even if it entails a change in thinking of foe and friend. We need imag-

ination, audacious ideas, practical solutions, in addition to good will and love.

Recent international events are particularly enlightening. The Polish revolution was well enough timed and managed that it raised the hope of peaceful transformation of the whole Soviet system. The change was demonstrated as feasible, even when later gloomy events seemed to close the doors of welfare and freedom with tanks and martyrdom, and the Middle East crisis pushed the world to the brink of a third world war.

ALL these conflicts between desires and possibilities are only different symptoms of the same illness. Paralyzed by fear and distrust we do not dare to make blueprints for a future world. Progress begins, to end in an impasse. The ways of change are dangerous and confused and we have not yet achieved an ethical framework for a mankind emerging from the dark. We are using outdated intellectual instruments contaminated with the germs of dissension. Our preparedness for war is much greater than our readiness for peace. We know that huge sums are reserved for construction of weapons and many gallant men are thinking in terms of wiping out other gallant men. But who is evolving the structures for an intelligent and strong peace? How much money and thinking are invested in the construction of integrative ideas, useful for friend and enemy? How many scientists are working in terms of the general interests of man? Surely the United Nations is a major hope, but the basic effort must be made by millions of persons and by many institutions from both sides of the iron curtain if a new world is to be constructed. By action or by inaction we are responsible for the march of events, and our responsibility is related to our degree of freedom.

The solution is not a weak pacifism, but a stern intellectual labor based upon strong sentiments of fairness and justice. Our problems are different from the ancient ones. A second Industrial Revolution began with the use of nuclear power and a new technology, producing thermonuclear weapons and automation; a new theory of relativity changing our ideas of matter and energy; quantum mechanics transforming our concepts of determinism and indeterminism. The principle of complementarity has revealed unity and diversity, freedom and organization, individual and social realities, as different compatible aspects for an integrated man. Many new roads are now open if we apply the solutions of our age to the problems of our time, giving up the theories which arose in darkened centuries. Convergence is possible if we are able to translate the ideas of modern history, philosophy and science into economic, political and ideological terms comprehensible to all, which can orient human action toward common goals.

THE scattered movements of synthesis, scientific dialectics and philosophical integration can be useful for practical and immediate work if they are put together. But if they fail, new uncompromised intellectual forces must emerge to perform the task. A tremendous amount of scientific and technological knowledge is available to construct a philosophical generalization of universal value. We have at least an initial point of agreement in the fear of mutual annihilation in a total atomic war. The effort, surely, must be of international scope. However, America, backed by the prestige of its organized freedom, ethical standards and powerful individual and collective resources, could take this initiative to launch it on a world-wide scale. Ideas of man have made thermonuclear weapons. Human ideas can fire the organic metamorphosis of modern man toward indestructible peace.

THE DIMENSIONS OF THE TASK IN EDUCATION

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The Necessity for Developing Man's Primary Resource: Creativity

AT no other time in our history has so much been said about education by so many as in recent years. While this flood of general discussion continues, trustees of educational institutions and Boards of Education are holding equally long and verbose conclaves on the problems of financing education. Of such discussions there seems no end and there also seems to be little accomplished in reaching firm conclusions to which majorities can subscribe. Why is this so?

When problems such as education, world peace, disarmament, etc., reach the point of long and almost fruitless debate, one suspects that semantic blockages are operating to prevent arrival at conclusions. This seems to be the situation regarding education and its financing, and we are led to suggest that we cannot hope to get very far until we clear our minds of a great deal of verbal clutter.

Let us start the discussion with some consideration of the word "education" itself, which is used so freely and loosely that it gives the illusion of being a common term that everyone understands. Yet discussion of the subject presents a confused picture. Some equate education with "schooling." Some conceive education as "training." These are in conflict with others who characterize education as "developing the mind." Both in turn differ with those who believe that education is an additive process by which facts are accumulated for the purposes of practical living. Still others stress education as "group adjustment" and a few voices are heard to argue for education as "mental discipline."

It is, therefore, no small wonder that discussion becomes still more confused when the social purposes of education are considered. At this point some stress literacy as the prime and major goal, others wish to see education "for action" (usually of a practical sort), many rally to the symbol of "citizenship," and a few are still to be heard pleading for more "culture."

It is probably not unfair to say that most of us are badly confused as to why our children should be educated and as to the results we expect to get from the process. When this point is reached by the irate taxpayer whose public school tax bill has increased 200% in a decade, he can be heard to declaim that we should go back to "the good old days" when only those who could profit by it received high school or college education.

Apprenticeship for nearly all trades and vocations has largely been thrown upon the schools. The belief is widely held that, unless one has had a course or courses in any subject, no matter in what field, he is unqualified to apply himself to that subject or activity.

Then, of course, there are those who hold that education is the acquisition of those arts which are becoming to a free man. Many fortunately still value the capacity to think, even if some have interpreted thinking to mean problem solving which results in better action.

Although this list could be further extended, it should be sufficient to document our case that the problems of education cannot be solved until we agree upon what is meant by education.

LET us propose, therefore, that education in American culture has three functions. First, it is our means of implementing and developing our society by schooling its members in the principles and practices of citizenship. Second, education has become increasingly a program of *basic* training in fundamental skills for the man-power pool required by our complex way of life. Finally (and this does not apply to American culture alone, but to the whole human race), *education is the development of humanity's primary resource.*

One could very easily say that this last purpose of education is the *only* purpose, but to be conservative we admit the other two more specialized and less basic functions. Certainly citizenship and training can be largely subsumed under the latter heading.

Slowly we have come to learn that man creates a society in terms of reality. In primitive nature-cultures this is not so apparent, as "reality" in such cultures tends to be a matter of agreement or consensus as a result of generations of acceptance of, and adaptation to, life in some particular local habitat. Even in an agrarian society, man's function as creator of reality can still be easily obscured by adaptation. But in our complex, technological culture, man's control over the operations of some of reality is more clearly shown. A few examples are in order. For brevity's sake, we

shall use the phrase "create reality," for the full terms which mean that man modulates what is given by the real.

Man moved up from the stone age to the age of metals by attaching importance and significance to certain materials in his environment. Man got along very well for many centuries in a reality which possessed only four elements: fire, air, water and earth. But modern chemistry (resulting from concepts in the human mind) has created a wholly different reality. Atomic energy has existed ever since creation but it was only recently that the minds of men brought it into controllable reality. Diseases have always been caused by what we now hold causes them—and that which cures disease today would also have wiped out man's scourges in the stone age—but the "real" causes of diseases and their "real" cures were unavailable until man's mind first created that reality.

Uranium has always been in the rocks where we now find it. A few decades ago it was only real enough to be an odd and rare specimen in a museum. Dictionaries published quite recently referred to it as "a worthless metal not found in the United States." But the minds of men created "real uses" and "real needs" for uranium and today it is a very important part of our reality.

Electricity was "real" to the ancient Greeks, who were doubtless amused by its trick of picking up bits of lint upon an amber comb which had been rubbed with silk. But human minds have created a world of electric and electronic reality. Radio waves, naturally produced by static electricity, thunder storms, volcanic eruptions, etc., have always been in the atmosphere. They were not part of man's reality until the minds of Clerk Maxwell, Marconi and others created their roles in society.

OUR examples should not be restricted to science and technology. The music of Bach, Beethoven and other composers is part of our reality. But that reality did not exist as sound or as black marks on paper until it was created in the mind of the musician. All creative artists have contributed to reality, but their works had first to be realities in their own minds. Likewise, the insights of Jesus, Lao-Tze, Buddha, Socrates, Schweitzer, and all other great thinkers are definite parts of our reality. There is no escaping the fact, however, that these insights have been given us by and through the minds of these individuals.

The Magna Carta, the Declaration of Independence, the Gettysburg Address, the Charter of the United Nations, democracy, communism, etc., are real parts of our world, but they first came from the minds of men.

What we are saying, therefore, is this: that no reality exists for us on the human level except as it is brought forward by the minds of men.

Education must therefore be defined primarily as that process whereby the minds of men are nourished, disciplined, furnished with experience, and encouraged to create. In no other way can this fundamental resource of the race be developed.

A second principle emerges from this and serves to elaborate a consideration of education as citizenship training and recruitment of skilled manpower. It is obvious that every invention—whether of a bow and arrow, a sail, use of horses for transportation, a zipper, an atomic bomb, money as a means of exchange, or a new form of government—since it is a change or modification of reality, has its effects upon human social behavior and organization. Not only are inventions human in origin, but evaluations made of them, and the uses to which they are put are also human. Creations made by human minds are therefore evidences of the capacity of human beings to seize upon, to assume responsibility for, and to take control over the direction of their own evolution.

It is, therefore, obvious that, while history can be viewed as a continuous process of creation of reality, it is also a process of continuously modified adjustment or adaptation to changing reality. Education, moreover, is absolutely essential in its functions, (a) of adapting humans to citizenship in the currently-prevailing and immediately-foreseeable reality, and (b) of equipping men as the operators and intelligent coordinators of these realities.

EDUCATION may thus be defined as the process designed to develop the basic resource of creativity from which human reality springs, and to give fundamental training for useful life amid the realities presently existing. Unless education is defined in these broader terms, any changes which are made in its structure or function will be crippled by the restrictions imposed by narrower frames of reference. The future of human society and the very nature of human realities developed by minds so educated will suffer from the same narrowness of viewpoint and definition.

In the face of the vast population increases with which elementary and secondary schools are now struggling (and with which institutions of higher learning must soon contend) we must be warned that, almost without exception, participants in all discussions to date have failed to lift education from relatively narrow contexts. This applies even to the recent White House Conference on Education and to the newly-issued Preliminary Report of the President's Commission on Education Beyond High School.

As for the critical problems of methods of financing education, much the same criticism of narrow viewpoint can be made.

Financing public education by levying taxes upon real estate is becoming an impossibility. This method, suited to an earlier day, is no longer adequate because of changes in our economy, changes in our entire way of life, changes in the kind of education which is suited to current and imminent realities, and changes in the numbers of those who must be educated.

State aid for public education as currently formu-

lated is inadequate as to the size of the financial aid, and also, it suffers from the same outmoded inadequacies which have been listed as restrictions upon local taxation on real estate. Federal aid for education, as generally considered, is not better than these other two financial sources for precisely the same reasons.

A few generations ago, private philanthropy was a vital means for financing education in the same social and economic contexts. But private philanthropy (even in the modern terms of the funding foundations) cannot long compensate adequately for the insufficiencies of public funds. At best, this is a temporary expedient. Corporation giving has recently begun to replace private philanthropy. It is, thus, a new experiment, but it suffers from the inherent shortcoming we have indicated.

WHAT, then, is the solution?

Just as we have argued that education itself must be lifted into a broader framework, so we propose that the dangers of half measures for financing education must be guarded against. We must wake to the realization that the education of a few generations ago has resulted in such changes in the realities of present social, economic, and material existence that a totally new method of financing education must be devised.

Let us be aware of a double danger: (a) Education which does not operate to the fullest scope of its broadest definition, and (b) Education which is restricted and undernourished by outmoded means of financial support will both widen the gap (already perilously broad) between material and technological advances on the one hand and social and ethical development on the other. And, to widen the gap even a little is to court disaster, as things now stand.

We have previously defined history in a number of ways. We must not forget H. G. Well's statement that "history is a race between chaos and education."

During World War II, this country financed a "crash program" for research into atomic fission. The choice was between the chaos of defeat at the hands of an enemy who had "beat us to it"—and the cost of financing the creation of such realities in the minds of men which would result in the power of atomic weapons on our side.

Is the race between chaos and education any less urgent in our present situation? Is not some drastic economic restructuring required to finance the necessary educational crash program?

Where will the money come from? The answer is that it can be found in the same places in which the means to finance another war would be found, were it to break out tomorrow. Inevitably, we have been drawn to using the financing of wars as examples of fund-finding in emergencies which threaten survival. A moment's quiet meditation will indicate that the parallels are quite exact.

FINALLY, we must go one step further. At the risk of triteness, it must be pointed out that, until eleven years ago, men could count on a continuing future for the race even though war and rumors of war were considered to be inevitable realities. In those times it was relatively adequate realism to forestall wars by arms races, balances of power, etc. Present realities are such that these are no longer to be relied upon. But, throughout the world the human race is paying uncountable amounts in an armaments race because we lack a better means for living amid our present realities. It seems that this is our fate for the foreseeable future until some social invention is created to make wars a matter of past history. If we adopt a crash program to finance education as has been suggested, we shall, of course, be paying a double bill. But, if among the millions that would be thus adequately educated some one mind were to create a warless reality for mankind by some new social or moral invention or concept, that man would indeed pay well for his education!

Many have said that although we need technicians to maintain and advance our technological culture, and although we need scientists to create ever newer realities in the physical and material spheres, we desperately need men who are capable of leading us to moral and social advancement. This is all too true. However, let us replace this statement by saying we need men who can create in their minds the social and moral realities which, if made actual, can accomplish what wars and armaments races cannot.

Then, whatever the crash program necessary for such education may cost, it will be more than offset by lifting the cost of wars from the backs and hearts of men. Is this not justification for our suggestion that some drastic restructuring and reorganization is required to finance education?

This is a call to everyone concerned with, or involved in, education. It is also a call upon everyone in legislative and executive authority in all levels of government:

"BE IT RESOLVED that we shall hence-forward give education a frame of reference commensurate with that factor in human life with which education is most directly concerned: *the human mind.*

"BE IT FURTHER RESOLVED that, in considering education, we shall concern ourselves primarily with the development of the only resource of the human species, the ability of the human mind to create its realities.

"AND BE IT FURTHER RESOLVED that we shall allow no fears, hesitations, or outmoded patterns to handicap our efforts to finance adequately the development of this resource."

Towards a Theory of Values

IN two issues of *Behavioral Science,* for April and July 1956, Nicholas M. Smith, Jr. has published an extended article on "A Calculus for Ethics: a Theory of the Structure of Value," of which the essential argument follows, much compressed and shorn of mathematics and diagrammatic illustrations.

A formal theory of values can be developed on the basis of the theory of probability, by associating with every state of a system a value which is defined as the sum of values of future states multiplied respectively by the probability of reaching them. The value to be associated with a thing or commodity will be its value in its environment. If the various numerical quantities which measure the state of a given system can decrease but can never increase, it is called an attrition system. A state of a system from which the probability of escape is zero is called a "trapped" state. In general, the values of future states are expressed in terms of other states still farther in the future, and so on ad infinitum. Thus, in order to obtain a solution of the value equation, it is necessary to define some boundary conditions under which the values are assumed to be known. In the case of an attrition system, it is assumed that it must eventually come to rest in some one of a number of trapped states. In a gambling game, for example, it is assumed that some player will eventually hold all the money if the game is continued long enough. In nonattrition systems arbitrary values must be introduced for states so far in the future that prediction becomes impossible. Value theory is closely related to decision theory. Decisions rest not only on the probabilities of outcomes but upon the values of these outcomes.

If many of us can agree on our basic value postulates, and if furthermore the decisions are made consistently with respect to values determined from these value postulates, then there can be a source of common or uniform action. Or the viewpoint of the cultural anthropologist can be taken and the behavioral patterns of a culture observed in terms of decisions made. Next a search is made to find a simple set of value postulates to which these actions appear to be consistent. In an attrition system, there is a unique value structure corresponding to any given arbitrary assignment of values to the trapped states. This is illustrated by a war of annihilation between two opposing military forces in a situation where there is no possibility of reinforcement.

The value of a thing is defined as the difference in value between two states of a system which differ only by the thing under consideration. The value of things diminish as more and more of them are added to a system. This principle is called the Law of Diminishing Returns. On the other hand, one might propose a Law of Increasing Returns applying to a system from which more and more things are removed. It is reasonable to suppose that one seldom hears this law expressed because it applies to systems whose death is imminent and that do not exist long enough for consideration. The old saw to the effect that "a drowning man will grasp at a straw" is essentially a statement of the Law of Increasing Returns, applying to desperate situations.

In general, most systems are not always sharply defined, and are never completely closed, being embedded in an environment to which they are coupled in various degrees. One must constantly remind himself that his rational operations pertain to a *model* having characteristics abstracted from the wide range of his percepts. The decision problem itself must generally act as a guide for the formation of a model.

Certain postulates are believed to be basic and fundamental to all systems:

1. All systems strive to perpetuate themselves.

2. There exists a limiting set of state probabilities for any system as it is considered further and further into the future. These limiting values result from the increasing unpredictability of the system states and the increased variability of the transition probabilities.

3. Ultimate death of a system is inevitable.

Individuals, nations, even whole cultures go through a cycle of adolescence, maturity, decline, and ultimate destruction. The sun and stars go through their own cycle of birth, evolution, maturity, decline, and death. Entire galaxies of stars have their own history of evolution. Atoms, even fundamental particles, are subject to change. It appears that all things that are identifiable as systems are transient in character. Such religious doctrine as concerns the existence of an immortal state and the indestructibility of the human soul will not be discussed here, although these exist as very important postulates that lead to the establishment of values.

4. The value of a state of a mortal system depends in general upon the path taken to the ultimate, inevitable death.

5. If death of the system, though inevitable, is in the completely unpredictable future, values are assigned as if immortality has a finite probability.

If the concept of immortality is strongly adhered to as the death of a system approaches, it may be expected that increasingly desperate and "irrational" (to one not facing the situation) measures will be taken. In terms of value theory this effect is closely related to the observation of moralists that the well-balanced individual continually has in mind a sense of the tragic component of life.

When the same state exists simultaneously in two overlapping systems and has different values in the different systems, conflict arises. These may be resolved in three ways: 1. By the complete dominance of one system with respect to all decisions common to both; 2. By schism, that is, by agreement that one system shall dominate in certain areas or circumstances, while a second system shall dominate in others, as between federal and state governments; 3. By an important method called "concrescence," a name borrowed from Whitehead, which represents a creative synthesis in which one decides to consider a more inclusive system in which both the conflicting systems are entirely contained.

The resolution of conflicts by concrescence is fundamental to the dynamics of the growth of value systems. Occasionally, as a system evolves, a set of elemental values will be condensed into a single value. The foregoing statements pre-suppose that the resolution of conflict is to be considered an absolute virtue, and, in common with usual scientific doctrine, that simplicity is always desirable. A "Law of Diminishing Weight" is also postulated, according to which the values first postulated for the system have an overwhelming weight, whereas newer constructs have an effect that diminishes with their degree of newness.

The process of concrescence has a close logical analogy to the so-called scientific method. It has previously been discussed by Hegel as the "dialectic," and still earlier by Plato as the synthesis of the thesis and antithesis. The dialectic of Marxism is not a dialectic in the Hegelian sense, but the dominance of one class and the suppression of another. True, the conflict is removed, but not by concrescence.

There are two diametrically opposed viewpoints as to the nature of ultimate values. One involves a concept of absolute values, the discovery of which becomes the prime objective of the experimentalist. The other regards ultimate values as essentially relative, and as mere constructs of human rationalization.

In the framework of value theory, the postulates of the immortality of the soul and of the existence of God are to be considered valid in proportion to the degree of consistency and lack of conflict they permit in rational decisions processes.

Finally, a principle of analogical conformity is proposed, according to which there exists a single rational form to which the form of any particular science or reasoning is homomorphic. This is thought to be a more general form of probability theory. The principle implies that the law of physics will have their counterparts in game theory, economics, psychology, and other sciences. It is as if the great laws of science such as those of the conservation of energy, the second law of thermodynamics, etc., are the inevitable product of the form of the rational process. The problem of science becomes one of determining the substance of experiment and observation that enables the formation of the constructs that lead to these inevitable formulations.

Evidences and illustrations which support the plausibility of this principle are found in quantum mechanics, in the special theory of relativity, in the uncertainty principle, in economic models, in psychology, in psychiatry, as well as in the description of the rational process. It is believed that value theory provides a technical language and formalistic approach that may add materially to the unification of the rational disciplines.

—T. N. E. Greville

Negative Entropy in Living Systems

IN the Annals of the New York Academy of Sciences, Volume 63, *Dynamic Anthropometry,* published November 28, 1955, L. Brillouin discusses "Entropy and Growth of an Organism," from the point of view of a physicist.

The main consideration of the article is the application of the general rules and principles of thermodynamics in biology and the extent of their usefulness. The view of a physicist, in considering a closed system, is embodied in two principles: (1) the energy of the system remains constant; and (2) a quantity called "entropy" increases, or at best remains constant. Entropy is characterized by "degradation of energy," whereby high-grade energy (mechanical power) has a tendency to be transformed into low-grade energy (heat). The grade of the energy can be defined as the negative entropy, or negentropy, a quantity that must always decrease in the normal evolution of a closed system.

A living organism, however, is a stable system but not a closed one. If an organism is confined, and its life is investigated, the general principles of thermodynamics would indicate that, while the total energy remains unchanged during the organism's processes of eating, doing work and discarding refuse, the entropy must increase. Assuming an adult organism to maintain an approximately stable stage, it may be said that entropy of food is smaller than entropy of refuse, or, an organism feeds on negative entropy. This is the problem of metabolism.

In a discussion at Harvard in 1948, P. W. Bridgman said, in effect, that in order to define the entropy of a chemical system, we must be able to find a reversible chain of reactions by which this system can be derived from another one, of known entropy. But as birth and death of an organism are irreversible processes, the entropy of an organism cannot be defined. This leads to the conclusion that one should not speak of entropy for living systems.

As previously stated, a living system is a stable open system, like a flame. Of such Prigogine has stated the following general principle: A stable open system, maintained by irreversible processes, assumes a structure corresponding to minimum entropy increase.

Brillouin also discusses another recent extension of thermodynamics which has taken place in the direction of the new theory of information. It has been found possible to give a scientific definition of the word "information," and to show that information is synonymous with negative entropy. "From study of a physical system, it can be shown that entropy measures the lack of information about the detailed structure of the system. It is a fact that we can never know exactly where all the atoms of a gas are located. This lack of information means that there is an apparent disorder in the detailed organization of the system, and this is, essentially, what entropy measures. . . . If information is negentropy, so also is organization. An organized structure is one about which we have complete information. It has a larger negentropy than a disorganized system. Now we begin to see the connection with life. A living system is organized. If we can define and measure its degree of organization, we may be able to define the negentropy characteristic of the living organism."

In considering the growth of an organism from a fertilized egg, all the information about the living system is contained in the chromosomes. If the code represented by the chromosomes could be deciphered, the detailed structure of the adult organism could be predicted. "The whole negentropy of the final organization is contained in the fertilized egg. But is it possible to read out the information without destroying the egg? N. Bohr has repeatedly emphasized the fact that there is a special uncertainty principle applicable to all living organisms, i.e., that it is impossible to make complete measurements on an organism without killing it. We cannot determine the complete chemical structure of a cell without destroying it. No scientist has yet been able to state precisely what this limitation means, but it certainly exists. . . ."

—Alan Mannion

Language Barriers Among Birds and Bees

THE November 3, 1956, issue of *Nature* (Vol. 178, p. 970) has a brief article on "Bird Semantics," which we quote verbatim:

"Most birds have a rudimentary language. A crow, for example, gathers its flock by uttering a distinctive assembly call and disperses it by squawking an 'alarm call.' The flock will respond to tape recordings of these calls just as it does to the cries of a live bird.

"Two research groups, one in the United States, the other in France, recently exchanged tapes on which they had recorded the calls of their native crows. Their object was to learn whether French 'crows' (rooks, jackdaws and carrion crows) would understand the language of the American eastern crow, and vice versa (*Scientific American*, August 1956). Roosting French 'crows' consistently ignored the alarm call of American crows; but more than half the French birds were aroused by the broadcast of an American 'gathering' call. American crows were wholly unmoved by the plaintive cries of nestling rooks or the strident assembly call of adult jackdaws—commands which all three species of French 'crows' invariably obey.

"In further experiment, the French investigators broadcast the food-finding and alarm calls of the American herring gull, a bird that also dwells on French coasts. The French gulls paid no heed to the American calls. From these experiments the investigators concluded that birds learn the language of their kind from older birds from their own group. The investigators included R. G. Busnel, J. Giban and Ph. Granet, of the French National Institute of Agricultural Research; the Americans were Hubert and Mabel Frings, and J. Humber, of Pennsylvania State University and the Mount Desert Island Biological Laboratory."

Is this the result of genetic or of environmental factors?

Additional data in the same field is supplied in an article entitled "The Path Between Genes and Behavioral Characters," by John L. Fuller of the Roscoe B. Jackson Memorial Laboratory, which appeared in the *Eugenics Quarterly* for December 1956. The individual differences in personality which are conspicuous in birds and white mice, as well as in dogs, horses, monkeys and men, are generally considered by geneticists to be in some part the result of hereditary constitutional factors. In the human situation, contributions of hereditary and environment to behavioral characteristics are difficult to disentangle, but in spite of this, the consensus among geneticists is that heredity has a very pervasive effect upon behavioral varability.

In the case of laboratory animals, it is not intrinsically more difficult for the experimenter to develop stocks with a particular form of behavior than it is to develop stocks which are large or small in size, disease resistant or susceptible. Different breeds of fowl or dogs show patterns of behavior which are almost as good identifying characters as are size, color, and body conformation.

To the study of bird language cited above, another interesting contribution to research in animal communication is added by Mr. Fuller:

"[Bees] are known to communicate with each other by means of dance activity. Von Frisch has shown that the form of the dances conveys information to other members of the hive regarding the direction and distance of a source of food. Recently it has been found that the style of dance differs in Italian and Austrian bees. The basic mode of communication, the grammer of the language, is the same for both races, but one might fancifully say that the two groups inherit different vocabularies."

Mr. Fuller remarks that "learning probably plays a minor part in the development of bee 'language'." This view may be contrasted with that expressed by the French investigators of bird language, quoted above, that "birds learn the language of their kind from older birds from their own group."

—E. B. Sellon

NEWS AND NOTES

THE state of affairs concerning a force field for life processes, forecast upon general principles by Schrödinger in his remarkable little book *What Is Life?,* is now, it seems, not far from demonstration.

Dr. Ernest Pollard, Biophysics Laboratory of the Josiah Willard Gibbs Research Laboratories, Yale University, reports in *Research Reviews* (Department of the Navy, March 1956, pp. 9-13) upon certain developments in the physics of viruses.

Philosophically his account is of major significance in itself; when taken in conjunction with another paper, noted below, its value is greatly enhanced. We therefore gather the two into one whole and deal with them here in News and Notes. We start by paraphrasing Dr. Pollard's review of relevant history of the atom.

The Bohr model of the atom was developed in terms of physics, and that of Lewis and Langmuir chiefly in terms of chemistry. The several requirements forced issues, and at last what is now called quantum mechanics substantially satisfied both parties. Unnumbered problems still remain, but the types of field required for physics (which must lead back to mass and to the macrocosm) and for chemistry (which must be adequate for valence and even for non-living substances of organic origin) have been worked out.

A similar, but more remarkable, demand is now being made (once more by two great disciplines) upon the theory of the virus. A virus is alive. It has heredity, and in it the phenomenon of exchange between genes strung along parts equivalent to chromosomes takes place.

A single virus has a diameter of only about 500 Angstrom units. The hereditary substance is a molecular chain that is a very small part of this whole. "Recent work by Benzer at Purdue," writes Dr. Pollard, "has shown that if one takes everything very literally, the unit which is responsible for a hereditary trait can be confined as being in a space smaller than 6A in length. Six ten-millionths of a millimeter is getting down pretty small! Small as it is, Benzer and others are not yet finished, and still finer genetic analysis is possible."

Dr. Pollard summarizes and illustrates the research of many workers. The net result is to establish firmly the existence in the virus of all the necessary diversification of structure required for genetic behavior already known by various other means. As noted above, in the virus these parts are so minute that we have here particle dimensions which undoubtedly call for the postulation of force fields.

Schrödinger's conclusion is thus being actually tested. We are about to find out whether the force fields of physics provide the properties which are needed to explain the genetic behavior of these particles. If not, then one or more fields with characteristics suited to life will have to be devised. Dr. Pollard ends with these prophetic words: "It is in the expectation of the development of this dilemma that we can pause for the moment, and wait five years for experiment to progress to the point where there is either no dilemma or one of the sharpest kind."

We now turn to the other item, from quite another domain of inquiry. The Ciba Foundation held in London about a year ago the most searching inquiry into parapsychological phenomena and theory thus far provided. (The report appears as *Extrasensory Perception,* Little Brown, Boston, 1956).

For present purposes the significant paper was by Professor G. D. Wasserman, mathematician, University of Durham, "An Outline of a Field Theory of Organismic Form and Behavior," op. cit., pp. 53-70, and two of bibliography. This is a reduction of a book of some five hundred pages which Dr. Wasserman advises us will probably be more conservatively titled *Hypothetical Behavior Mechanisms.* It will be concentrated upon the very same entities which concern Dr. Pollard and his colleagues, namely, isomorphic biochemical mechanisms.

Thus it is clear that from two sides workers are closing in on *the* research problem of our time. Until a biological field theory is worked out and established empirically, the state of affairs which men like Maslow, Moreno, Sorokin and others so properly deplore in the sciences of man will remain.

In view of the serious neglect of this area, it is stirring to report that one industry, one part of government, and one small group of workers are—in spite of all other lethargy and lack of direct coordination—getting close to a great and needed new stage in the philosophy of science.

—*F. L. Kunz*

THE Foundation for Integrated Education was represented at the Annual Meeting of the American Association for the Advancement of Science in New York City, December 26-30, by a booth among the Foundations. Its neighbor on one side was the Naval Research exhibit, and on the other, the National Science Foundation.

In this good company, the display of recent issues of MAIN CURRENTS, of an interesting educational device which conveys the nature of a magnetic field very graphically (called the Magnetor), and other materials attracted a steady stream of visitors.

This is the first opportunity the Foundation has had to offer such a display at the AAAS since the meeting in Corvallis, Oregon, in 1952. The success of this venture was so marked that the Foundation is proposing to be represented at meetings of the American Physical Society, and on other occasions in future.

REVIEWS

The Growth and Structure of Motives, by James Olds

Reviewed by Ralph F. Hefferline

JAMES OLDS, author of *The Growth and Structure of Motives* (Free Press, Glencoe, Ill., 1956, 264 pp., Index, $5.00), has been in the news of late for another reason. Experiments which he performed on animals with electrodes implanted deep in the brain demonstrate that electrical stimulation delivered to certain subcortical regions may be used to reward an organism for whatever it has just been doing. For example, if an animal is placed in charge of the situation in the sense that his own action—such as pressing a lever—will close a circuit and give him a brief brain shock, he will continue to work the lever and thus stimulate himself indefinitely.

This finding both excites and alarms. To the researcher it raises the fascinating question of whether he can discover something similar going on naturally in the brain whenever an animal gets a reward of any kind. A darker side of the picture is the prospect it affords of a super-technique for brain-washing and controlling people. Already a preliminary application of the method has been made at the human level by investigators in a psychiatric hospital—with an eye, of course, to its potential usefulness in therapy—and the report is that psychotic patients behave with respect to brain stimulation just like rats, cats and monkeys.

Less arresting, but no less important in cumulative impact, are the more routine data now steadily flowing from the laboratories of scientific workers who, like Olds, look upon the human organism as a kind of brilliantly designed, but vastly intricate, electronic instrument. Paradoxically, the trend toward automation proceeds jointly on two fronts which might seem at first unrelated. On the one hand the human organism's anatomical design and behavioral characteristics supply the basic model for construction of the self-regulating machines called servomechanisms, and on the other the terminology, working principles, and even the electronic circuitry of the automation engineer are utilized in theorizing about and investigation into the human organism. In both cases results emerge which are novel and which find quick application.

"How dreadful!" or "How wonderful!"—which is said seems to depend mainly on whether one feels as a human being imperiled or perhaps degraded by such a development, or whether, on the other hand, one takes comfort in the possibility that methods may at last be close at hand for efficiently building into human individuals the sort of social behavior which has been espoused in common by all the world's great ethical systems but badly bungled by traditional educational practices. Whatever dangers there may be in the double-automation approach (and that there are some can hardly be questioned) one thing, at least, is certain. If men of good will consider their responsibility in the matter fulfilled once they have denounced the proceedings *in toto* and reiterated their belief in the dignity of man, then they will have failed to halt the movement and merely forfeited whatever chance they had to guide it.

The social implications of the automation approach as applied to human behavior are, however, far from what concerns Olds in *The Growth and Structure of Motives*. He is fully engrossed in technical problems. He has interrupted his experimental studies only to take stock and shape the strategy for further research. He points out gaps and invites help from fellow workers. His criterion of progress, as for all experimentalists, is increased ability to predict and control events within the situation under study. When the situation is the human situation, scientific advance proves itself to be such by more accurate prediction and control of human behavior. Any later exploitation of such gains in the service of special interests is extraneous to the scientific enterprise.

Most of the work which Olds reports has, for obvious reasons, been done on subhuman animals. He surveys the literature on experimental procedures for establishing and altering food preferences, for making rewarding what originally were neutral or even punishing situations and activities, for linking together sequences of behavior into action systems, etc. Only a reader incorrigibly fixed on the notion of man as a special creation could fail to see systematic relevance of such studies to the understanding of man.

Structure, as conceptualized by Olds, is in line with much recent writing. It involves the premise of a dynamic system.[1] He is concerned with how such dynamic structures get built in the course of organism-environment transactions. This, with a difference, is none other than the old problem of how it is possible for an individual to "profit from experience."

Psychological theories have always postulated some kind of "trace" which persists in the organism and makes its response on second and later encounters with a situation different from what it was the first time. Older theories—still with us as everyday "commonsense"—put the "trace" vaguely in the "mind" as "memory." But modern workers seek something more specific—something susceptible even to quantitative manipulation. The question becomes one of tracing out actual changes in biological structures as the individual accumulates experience.

For Olds the crucial changes are located in the brain. Nerve-cells which are active in close sequence become organized by a growth-like process, it is thought, into what Hebb[2] has called "cell-assemblies." Evidence now exists for the orderly firing of nerve-cells in loop-like chains which are designated "reverberating circuits." There are complicated gradients of interactive effect. For instance, the firing or discharge of a particular cell may not be sufficient to produce actual firing of an adjacent cell, but may so change the condition of this adja-

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[1] Ralph F. Hefferline "Dynamic Structure in Human Behavior," *Main Currents*, 1955, *11*, 116-117.

[2] D. O. Hebb. *The Organization of Behavior*. New York: Wiley. 1949.

cent cell as to "facilitate" its discharge. Since "cell-assemblies" are subordinate structures in higher-order assemblies, the total system is capable of an almost infinite number of "hook-ups."

Such a formulation, if it can be worked out in detail, will make concrete the manner in which the individual "internalizes the world." That we recognize quickly and without difficulty what we have seen many times Olds would account for in terms of a cell-assembly which has been gradually developed and which now has many reverberating ramifications. When an object has been seen from various angles and distances, under different lighting, while one was in diverse moods, etc., it acquires "representation" in a neural structure which can be activated by any one or more of the patterns of external stimuli which played a part in building it. When we instantly recognize a familiar object on the basis of but a few of its many possible aspects, much of what goes on is a kind of "conditioned seeing."

During the war airplane spotters were trained to identify makes and types of aircraft by presenting their silhouettes very briefly on a screen. What at the start were scarcely detectable blobs came with training to be specifiable in full detail.

This may seem to be no more than the old notion of the "association of ideas," and certainly it is intended to cover whatever was covered by that term. What is different is the precise specification of stimulus conditions and their consequences and the complete disappearance of the view that anything may be capriciously dismissed as ephemeral if it is "just something in your mind."

The most original part of *The Growth and Structure of Motives* is the final section, entitled: "The Structure of Intrapersonality Action Systems." Olds minimizes his contribution by calling it merely an extension of "The General Theory of Action" worked out by Parsons and others at Harvard.[3] He tries here to accommodate his theory of cell-assemblies to the richness and complexity of experience as it is viewed by the human actor himself. His treatment of the life-span as a series of "short-term low-contingencies" and "long-term high-contingencies" is too involved for brief summary.

All told, this book will provide an exciting adventure for whoever is ready for it. It requires some background in the experimental approach to human behavior and, because so much of it is newly organized or reorganized material, it will take repeated exposures to it to build up the "cell-assemblies" necessary for its full comprehension.

It does a little building at both ends of a bridge which might eventually supply firm, continuous passage back and forth from man's personal mode of experiencing himself to the necessarily abstracted, schematic, non-subjective way of dealing with the same subject matter which constitutes science. What is needed for such a bridge is neither popularized science nor scientized personal experience, but, instead, a sophisticated, fully scientific account of how personal experience comes to be what it is. Such an account would not *be* the experience. One lives a life; one does not live organized knowledge. But such organized knowledge would specify the conditions under which this or that form of personal experience could and would occur. Ultimately it would reveal what are optimal conditions for man's life and hence what is appropriately human to strive for.

[3] Talcott Parson and Edward A. Shils, Eds. *Toward a General Theory of Action.* Cambridge: Harvard. 1951.

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Non-Verbal Communication, by Jergen Reusch and Weldon Kees

Reviewed by Lawrence K. Frank

NON-VERBAL Communication, by Jurgen Reusch and Weldon Kees (University of California Press, 1956), gives a broad picture of how much communication takes place, through visual perception of objects, animals, events and situations, and persons and groups. Reading the text and studying the many fascinating photographs, we realize how largely our lives, especially our interpersonal relations, are oriented and conducted through the various modes of non-verbal communication, recently termed *Kinesics* by Ray Birdwhistle. This volume literally opens our eyes to what we usually do not perceive or recognize, and enlarges dramatically our awareness and understanding.

The authors, Jurgen Ruesch, a psychiatrist, and Weldon Kees, a poet, critic and film producer, have systematically examined the varied forms of non-verbal communication, approached both in terms of a basic theory of communication and through a wealth of photographs which convey and illustrate what cannot be put into words.

Unlike many studies of communication which deal with abstractions, fractionated bits and statistical regularities, the authors are concerned with the direct perception of multi-dimensional events in all their compelling actuality. They show us these non-verbal communications in their social-cultural, as well as their spatio-temporal, contexts. Thus we see the relativity of all events and begin to realize how much our interpretation of messages is governed by these accessory or concomitant cues. Indeed meta-communications, which tell us how to decode and interpret messages, emerge as a crucial aspect of human communication.

Some of these meta-communications are intentional, the sender deliberately cueing the recipient how to interpret his communication. But many are sent without intention or even awareness that they are being sent. We "telegraph our punches," we "tip our hand," we betray and often contradict our spoken words by gestures, facial expressions, postural changes as well as tones of voice. These meta-communications are therefore essential to those who wish to understand and correctly interpret what others say, often revealing the concealed intentions and feelings of a person. Moreover they are highly significant for those who are attempting to observe human behavior, since too narrowly focused observation of activity with neglect of these meta-communications may lead to egregious errors.

This is especially relevant to the understanding of

people of other cultures, each of which has its patterned actions, gestures and expressive movements according to its traditional modes of communication, especially of interpersonal relations. Failure to interpret these varied non-verbal communications correctly may block all communications.

In their discussion of recent theories of communication and methods for study, the authors emphasize the basic difference between *analogical* and *digital* codification. They point out that words which are step-by-step, digital, like numbers, cannot present the immediacy and totality of continuing action, while non-verbal communications relying upon analogic processes convey information in actions, pictures, objects, situations, even models which can be perceived as a whole and, since they persist, can be held in focus and intently observed.

This leads to a discussion of the development of communication in man and the historical development of non-verbal communications, as disclosed by stone tools, weapons, and domestic objects, and ruins of houses and temples. Among these are early communications and cave paintings which "bridge the gap" of time, conveying information about people from whom no auditory or written records are available. Languages such as pictographs, ideographs and hieroglyphics preceded phonetic systems of writing, which is a series of non-verbal symbols that we perceive and interpret verbally. The latest in the long succession of non-verbal communications are the comic strip and cartoons without captions, which, it should be noted, are similar to the early religious paintings showing a series of episodes in the lives of the saints.

The arts, both the graphic and plastic arts, dance and acting, especially pantomime, are familar forms of non-verbal communication, using visual perception to communicate what is often difficult, if not impossible, to convey in words, verbal or written.

Action language, probably long antedating speech, appears in reflex actions, "gritting the teeth," expressive movement and adaptive behavior of infra-human organisms, also the traces remaining after action, as in footprints, the wake of a ship, the tracks of a vehicle. Likewise action language appears in the hands of a person whose occupation is often revealed by their appearance.

Gestures, bodily appearance, facial expressions, the hairdress, cosmetics, grooming, and clothing or costume of a person likewise communicate much about an individual, sending messages which are perceived only visually (although we speak of "loud clothes.").

We begin to realize that non-verbal communication is of greatest significance but is often neglected or ignored because of our major concern for verbalized communication. Obviously the non-verbal must be recognized as an essential component in the communication process.

The discussion and illustrations of Messages through Non-Verbal Action and the Informative Value of Movement give new insights into human behavior, creating an awareness of how much is going on around us which we may or may not perceive but which may be highly significant. The human organism-personality is continually reflecting or exhibiting what is going on inside and what is going on outside to which he is responsive. We identify individuals by these visual appearances, as disclosed by their non-verbal communications, appearance, costume, status, occupation and relations to others. But again the context in which action occurs is essential to its interpretation since each action is relative to the situation, including the conventionalized situations which demand fixed behavior. But action when alone is also communicative, revealing the essential individuality of a person.

There is also an *object language,* as materials and textures, the shapes, form, surfaces, their order and arrangement and interrelation send messages, including visually perceived signs and indicators. The number and variety of letters, the abbreviations used, the juxtaposition of sometimes incongruous objects, including the variety of symbolic objects, all contribute to our daily orientation. They help us to order our experience and relate ourselves to the world. It might be added that when we view these objects and receive these visual messages, we usually decode these visual messages into the familiar verbal forms so that we can talk about them to ourselves in our inner speech. This is especially true of signs and symbols which indicate what we are expected to do and not to do, to find or to receive.

The continuity of a culture may be more largely dependent upon this object language than oral or written tradition, since we are continually reminded by the familiar appearance of the world around us of our basic assumptions and expectations, our cultural, approved *eidos* and *ethos.* Thus we identify and reaffirm the familiar well-defined world, as the buildings, churches, temples, monuments, houses, stores, factories, homes repeatedly evoke our traditional beliefs and aspirations. Probably the absence of a well-structured landscape gives pioneers more freedom from tradition to create a new way of life, as in the United States where people of European culture were able to create some new patterns and establish some new relations in an unstructured continent.

Just as each person has his individualized style of speaking, walking, working, playing, so he builds up his "life space" (so far as he can) according to his idiomatic taste, personal mode of living and of relating himself to the world and other persons.

The way people furnish and decorate their homes, especially what they use as familiar objects and household arrangements, will often yield much insight into their essential personality make-up. Moreover in this familiar setting, their gestures, standing or sitting postures, facial expressions, approach to or withdrawal from others, their choice and use of objects and utensils, all reveal what "they can't or will not say," as Henry Murray has remarked.

This Syntax of Object Language emphasizes not the simple object but the way objects are arranged spatially, with color, so that their use and functions are decorated, embellished, made contributory of esthetic fulfillment as a mode of personal self-realization. Often in these arrangements there are dominant themes, gestalts expressive of individual sensibility and formal preferences.

In their discussion of Language and Psychopathology, the authors emphasize the role of preverbal experience and the limitations upon psycho-therapy which relies exclusively upon verbalized communication, especially recall of past experiences which so rarely can be verbalized, even if remembered. Organ language becomes predominant in psychosomatic disorders and as a patient improves he shifts more to active language, like the psychopath who uses chiefly action language for communication. Reliance upon analogical rather than digital communication seems essential to treatment of psy-

chotics since only analogical, non-verbal communication can evoke relevant responses from such disturbed personalities. "Analogical codifications involve networks that include the almost simultaneous excitation of sensory organs, the brain and the glands and muscles. . . . In general analogically-perceived impressions exert a much more mandatory response than digitally-perceived impressions."

The increasing reliance upon play therapy, art therapy, musical therapy, occupational therapy, and physical therapy indicates that the importance of non-verbal communication, as the authors assert, is being recognized in psychotherapy.

In the concluding chapter, Toward a Theory of Non-Verbal Communication, the authors explore the further implications of sign language and object language, urging more study of non-verbal communication in analogical terms, as offering a promising approach to the unique individual.

This volume may be commended to readers, professional and lay, as both an intellectual and esthetic delight. It will repay repeated readings, since its variety and richness offer many leads to reflection and suggest a variety of problems for study.

Lawrence R. Frank is a lecturer in the Department of Planning, Massachusetts Institute of Technology. He was long an executive of the Josiah Macy Foundation, and was subsequently Director of the Caroline Zachry Institute. His latest book in collaboration with Mary Frank is *Your Adolescent at Home and In School,* Viking, 1956.

Fads and Foibles in Modern Sociology, by P. A. Sorokin

Reviewed by F. L. Kunz

GROWING impatience with behaviorism—along with constructive assessments of psychology—were put into words by Professor Abraham Maslow in MAIN CURRENTS, November, 1956. A similar manifestation among some sociologists is now expressed by Professor P. A. Sorokin in *Fads and Foibles in Modern Sociology* (Henry Regnery Co., Chicago, 1956, 317 pp. and 29 of bibliographic notes and name index, $10).

The book is written with an intensity which may be mistakenly attributed solely to situations inside the social science groups. We shall aim to show that the critical and even ironical form of expression derives from large and important considerations of the history of thought. The provocative manner and the comprehensiveness of content make the book highly readable. As to its general protestant tenor and major argument, this seems unanswerable. Without doubt the case had to be stated, and at length. Whether this controversial treatment is *sufficient* is a question time must answer. This may be said, however: The reader will feel the exhilarating stormy power of a clear and uncompromising mind upsurging from humanitarian promptings.

Sorokin's adversely critical case is that the numerous attempts at transfer of limited parts of the methods of physics to sociology directly and uncritically on the physical and operative level have led to an abundance of nonsense about quantities, a maximum of busy work, a maze of blind alleys, and a minimum of sense about man as he really is.

Society is certainly sick. The malady is known. Our author offers a prescription. What is not clear is where the patient is to go to have it filled. For this deficiency, however, no one discipline is responsible. Funds and foundations have their responsibilities for the failure, also.

This volume may be an opportunity to make a fresh start. We should, therefore, try to put it against its proper philosophical background by using some quotations to remind the reader of the neglect (which must be in Professor Sorokin's mind, at all times) to get at a task which has been before us for decades.

Writing in 1932 of many departments of knowledge, Professor T. M. Forsyth said (*Philosophy,* p. 54, vol. 7, 1932), "Recent developments both in science and philosophy are tending to converge upon an outlook on things that constitutes or at least fore-shadows a great new synthesis."

Even the *Encyclopedia Britannica* (14th ed., vol. 15, p. 84) could say "A prophecy may be hazarded that in the future these applications [of mathematics to physics, in this case] will unify themselves into a mathematical theory of the hypothetical substructure of the universe, uniform under all the diverse phenomena—of atoms, molecules, capillarity, diffusion, radiation, and the like."

Writing in *Free World,* October, 1944, Einstein himself observed: "Physics and mathematics are important for the community, firstly, because they fecundate technical development and, secondly, because like all finer cultural endeavors, they are efficient counter-weights against the dangers of sinking into an odious materialistic attitude toward life which leads to the predominance of unrestrained selfishness."

As for this book, read against the foregoing, Sorokin asserts that men and societies are phenomena of mind, intelligence, unconscious workings, reason, supraconsciousness, emotions of diverse kinds, cultural habits, and varied needs that must be examined indirectly, as well as directly. He holds that the massive accumulations of direct measurements of mind (e.g. through intelligence tests) and indirect (i.e., behavioral statistics) are for the most part social middens, the books composing them being comparable to deposits of shells, bones, and other detritus on the edge of a lake, that show that crude people hunted nourishment there. He shows that accidental social-physical congeries are many and varied; and that statistical treatment of them tells us little (and that by accident) or nothing (and that in words, often new in form but not in sense). Most of the book (about 250 pages) is first given to this analysis.

Sorokin then concentrates sharply on evidence that deeper than the behavioral surface is a social-meaningful substrate, with a fabric of its own, with its own rules —such as meaningful-causal connectivity—and that it is at this level that we come upon whatever is organic in human society, insofar as human society is more than animal. He holds that if we make measurement studies at that level, then meaningful measurement may be obtained. This must be in the *manner* of contemporary physics, but uniquely postulated and otherwise designed for the special subject, and not merely shifted as a bulldozer might be transferred from a gravel bed to a quicksand.

The method is examined in Chapter 11, pages 250-278. This chapter convinces the reader that *Fads and Foibles* is more than a comprehensive survey of the whole current state of inadequacy in social measure. Yet it leaves him uncertain. These questions call for categorical answer: What are the postulates? What part of extant mathematics and logic is to be structured? Shall we be obliged, perhaps, to invent the latter for this express purpose, as is done so often in the very same methodology when used in physics? Here a subject index would have been helpful, enabling the reader to gather together Sorokin's thoughts along these lines, for postulates and a structure are implied even if not categorically provided.

This book will help to clear the decks of sociology for action. It is undoubtedly timely. For field theory in biology is now getting to be serious business. Once that has been successfully established even in preliminary form, a similar resource for the study of man can be more hopefully opened up. In a valuable smaller book, *The American Sex Revolution* (Porter Sargent, Boston, 186 pages, no index) just issued by Professor Sorokin (January, 1957), we learn what has happened to our society in this one area, as criteria as to the purpose of human life have lost meaning. This we hope to review later. *Fads and Foibles* is the thirtieth and most recent volume by a scholar whose knowledge, insight, and intellectual courage have always been formidable, and remain undiminished. After the heat and confusion of controversy have subsided, these great original contributions will remain.

Niels Bohr and the Development of Physics, edited by Pauli, Rosenfeld and Weisskopf; and Quantum Field Theory, by Hiroomi Umezawa

Reviewed by Bohumir Larys

MODERN physics owes much to Niels Bohr in the development and conception of quantum mechanics. He occupies in this branch of physics a similar role which Albert Einstein occupies in the field of general relativity. His interpretation of quantum theory is still the most logical and is constantly confirmed by experiments. He is now identified with the Copenhagen school of quantum theory, to which school all physicists pay the most reverent homage. At the occasion of Niels Bohr's seventieth birthday, October 7, 1955, the book under review, a compilation of theoretical physics essays, was published. The list of contributors reads like a "Who's Who" in modern physics. They are: C. G. Darwin (Cambridge), W. Heisenberg (Göttingen), W. Pauli (Zurich), L. D. Landau (Moscow), L. Rosenfeld (Manchester), O. Klein (Stockholm), H. B. G. Casimir (Eindhoven), F. L. Friedman and V. F. Weisskopf (Cambridge, Mass.), J. A. Wheeler (Princeton), J. Lindhard (Copenhagen). These essays not only recapitulate past progress but also show where new developments should be and are being done. The book should be of help to graduate students trying to find a subject for thesis. There are some very new data, not as yet published in any other publication, such as the calculation of electron charge by L. D. Landau (Moscow).

The majority of the essays deal with quantum mechanics and the rest with the latest developments in superconductivity, nucleus, and nuclear fission. The reader will find such new laws as the conservation of charge, some conclusions that the mass of an electron can be of electromagnetic origin, discussion of infrared catastrophe, meson couplings, and other pertinent problems in the elementary particle theory.

THE author of *Quantum Field Theory* belongs to the Japanese school of theoretical physics of which the most renowned member is H. Yukawa, who formulated the meson field theory back in the thirties. The author is at present Professor of Physics at the University of Tokyo.

Whereas *Niels Bohr and the Development of Physics* reads like a series of disjointed scientific articles in the manner of the *Physical Review*, this book presents a correlated view of quantum field theory. It could be likened to a handbook, for it does not dwell on the fundamentals but expects the reader to be thoroughly versed in the latest matrix theory and its symbolism. It is, therefore, directed toward more advanced students.

One can almost feel that the author has here published a collection of his notes over several years. Such notes contain usually not only the author's ideas but also digests of various scientific articles as they appear from month to month in the main publications on physics.

Because of the manner in which this book was collected and written, it contains a lot of valuable information on elementary particle physics. From the reviewer's point of view, it includes the best up-to-date encyclopedic information on the various properties of particles, such as photons, neutrinos, electrons, π mesons, μ-mesons, π-mesons, and others which are not generally known. It gives their charges, spins, decay times, and so on. It also gives the history of the discovery, consecutive development, and laborious fitting together of the phenomena.

The book discusses the pros and cons of the phenomenological theory of nuclear forces (which is not dealt with here) and the conceptual theory of the elementary particles.

From the mathematical point of view, it develops the generalized equations of quantum field theory so that it is then applied to the elementary particles enumerated above. While some particles such as electrons have yielded to complete solutions, others do not, and the book shows the occurrence of infrared and ultra-violet catastrophies. Of course, there is no known catastrophe in nature, but the equations of interaction lead to it because of as yet insufficient conceptual understanding. The mesons and their role in nuclear forces as yet resist a complete solution. Since the phenomenological forces are 100 times larger than those calculated from charges and electromagnetic fields, it is apparent that the binding forces are of an origin as yet unknown to us.

The book can be highly recommended to a student in the advanced stage of quantum field theory or to a theoretical physicist for use as a reference.

In conclusion, the reviewer would like to comment on the amazing ability of the "Matrix Theory" to dig out the secrets of nature. It is pure mathematical formalism which many may find distasteful. However, it finds its usefulness here. One may imagine that complete understanding cannot be achieved by juggling of mathematical equations. Other discoveries yet to come and conceptions yet unthought of will be needed.

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Language, Thought and Reality, by Benjamin Lee Whorf

Reviewed by F. L. Kunz

IT is now certain that the late Benjamin Lee Whorf supplied an impulse and direction to studies in linguistics which can hardly be given over-emphasis. His papers have proved to be so necessary for international understanding that the Department of State collected as many as were readily available, for the men in their Service Institute. Gradually it is coming to be clear that here was a scientific and philosophical talent of the first order.

The entire life endeavors of celebrated creative scientific thinkers may, in due time, fairly or unfairly, come to be summed up in single words: evolution (Darwin), relatively (Einstein), quanta (Planck), genetics (Mendel). It will not be so easy to epitomize Whorf's contribution, for no single word in English identifies what he was about. The nearest terms are *logos*, or the Sanskrit equivalent, *shabdabrahman*. For his was, without doubt, the freest kind of intelligence at work upon the mystery of reason, sound, resonance, perception, language and linguistics, in their relation to contemporary science, which has at last demonstrated reality to us.

In a brief forward to a new book of Whorf's papers, Stuart Chase puts him in rank with Franz Boas and William James. In my opinion this but approaches the man's true worth. For his claim to greatness was not that he derived and stated the principle of linguistic relativity, but his insight into the fact that behind this invariants are to be found.

Who Whorf was, and nearly all that he said in formal papers, can now, fortunately, be had in one volume, *Language, Thought and Reality,* edited and with an introduction by John B. Carroll (Technology Press of Massachusetts Institute of Technology, John Wiley and Sons, New York, Chapman, and Hall, London, 1956, 270 pages and bibliography, $7.00). The volume concludes with an article on "Language, Mind and Reality," and this is as it should be. For in this article Whorf was beginning to outline his ideas for a book that he meant to write. Alas, for us! He died July 26 1941, at the age of 44. The article actually appeared as the last principal paper.

Professor Carroll has combined the loving insight that friendship prompts with the judgment and meticulousness of a scholar. Mrs. Celia Whorf and the children (especially Raymond and Robert), and Whorf's brothers have given assistance. Thirty-three pages are given to biography, and eight to the most complete bibliography of published and remaining papers of all kinds. The volume is definitive, containing as it does all the published essays, choice unpublished papers, scientific and philosophical letters, and notes, or drafts, or short articles. Perhaps more letters may come to light. But certainly this volume will stand for years. It is delightfully illustrated at appropriate points.

It was the good karma of this writer to have Whorf's friendship and assistance during the founding of MAIN CURRENTS, in the months preceeding November 1940, Whorf aided generously with advice, and wrote many items, especially reviews, most of which are included in the volume under review.

Mr. Whorf was born in Winthrop, Massachusetts, April 24, 1897, and died in Hartford, Connecticut, July 26, 1941. It was the brief transit of a brilliant star, the passing of a sparkling mind warmed with the peace which insight gives. It may be long before we see his like. To fill some of the void he left, we have this utterly admirable book, and give our thanks to all concerned in its production.

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